BATSE – The History and Legacy

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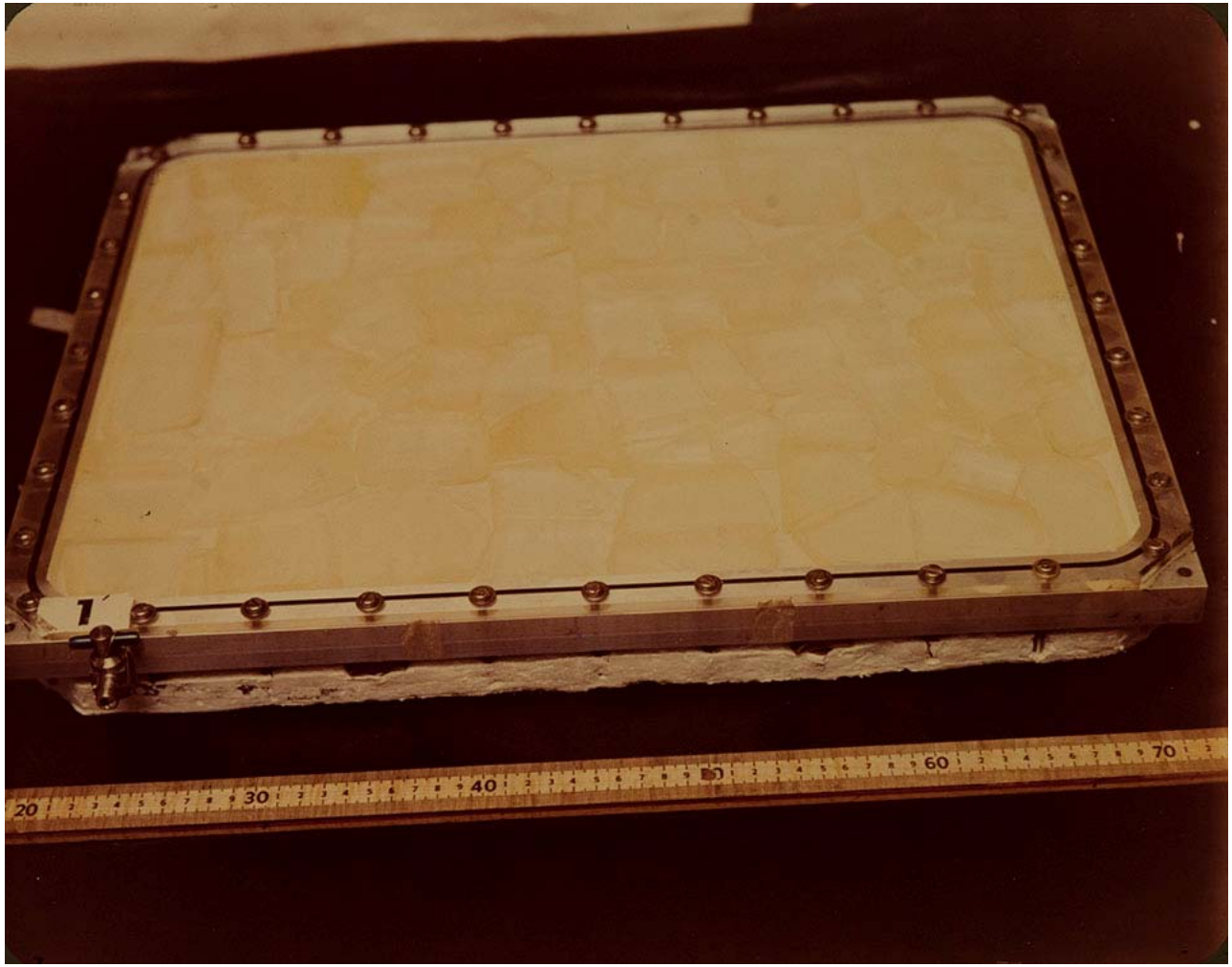
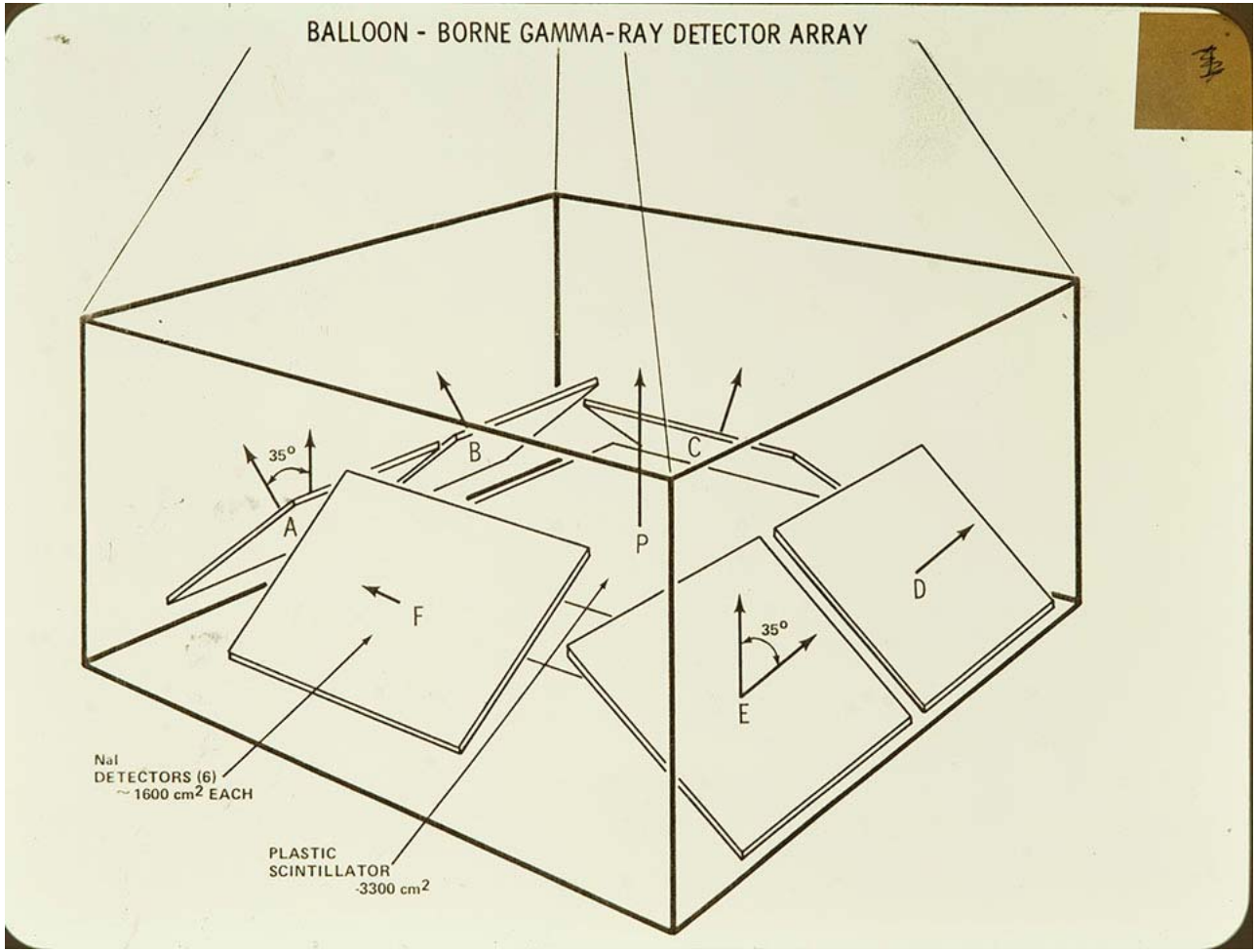
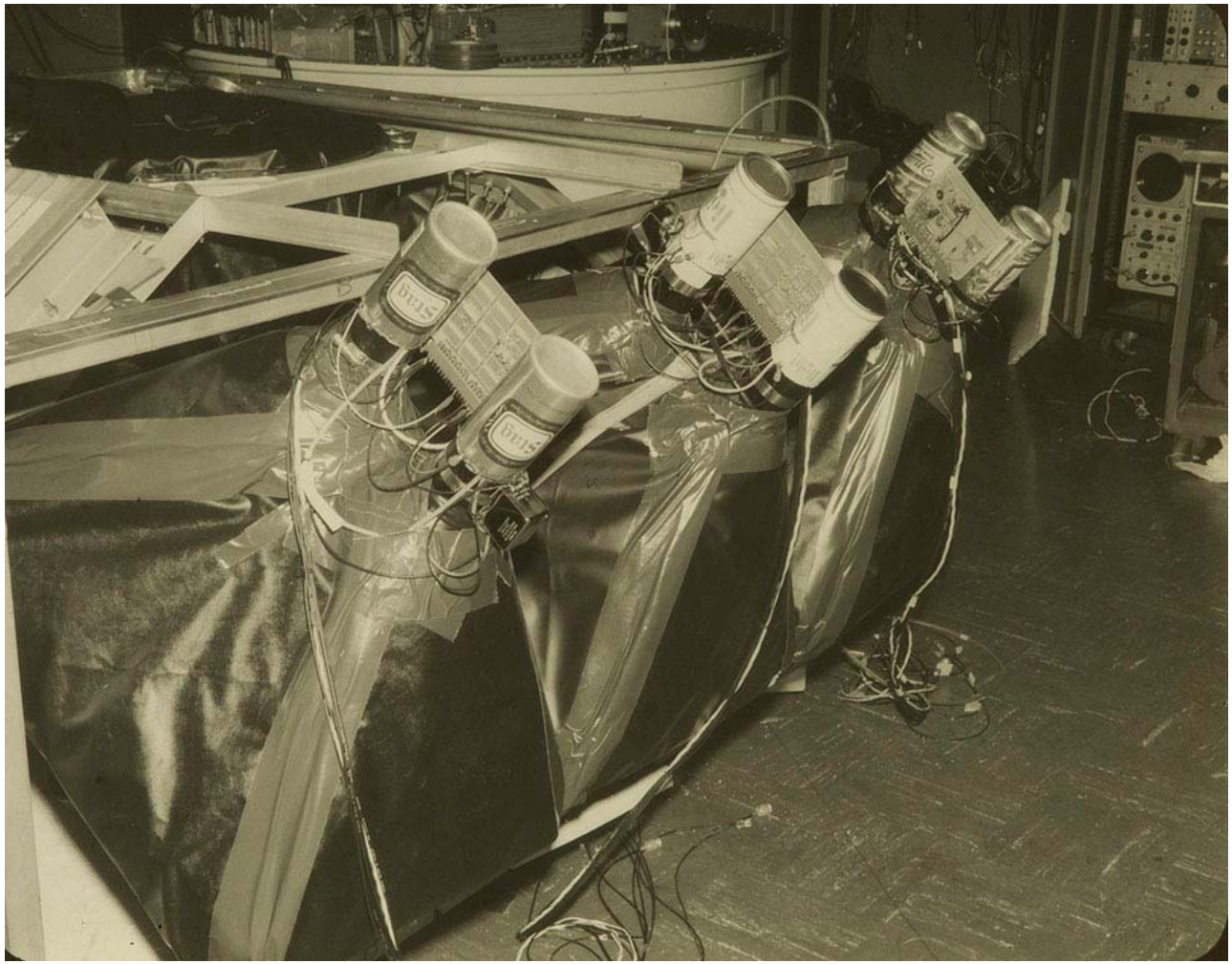
Detector Development
&
Early Balloon Flights

1975-1980


1
2
4
7
6
5
3


1
20
30
40
60
70


BALLOON - BORNE GAMMA-RAY DETECTOR ARRAY
35°
A
B
C
P
F
D
35°
E
NaI
DETECTORS (6)
~1600 cm2 EACH
PLASTIC
SCINTILLATOR
-3300 cm2



Proposing for BATSE; Negotiating after Approval

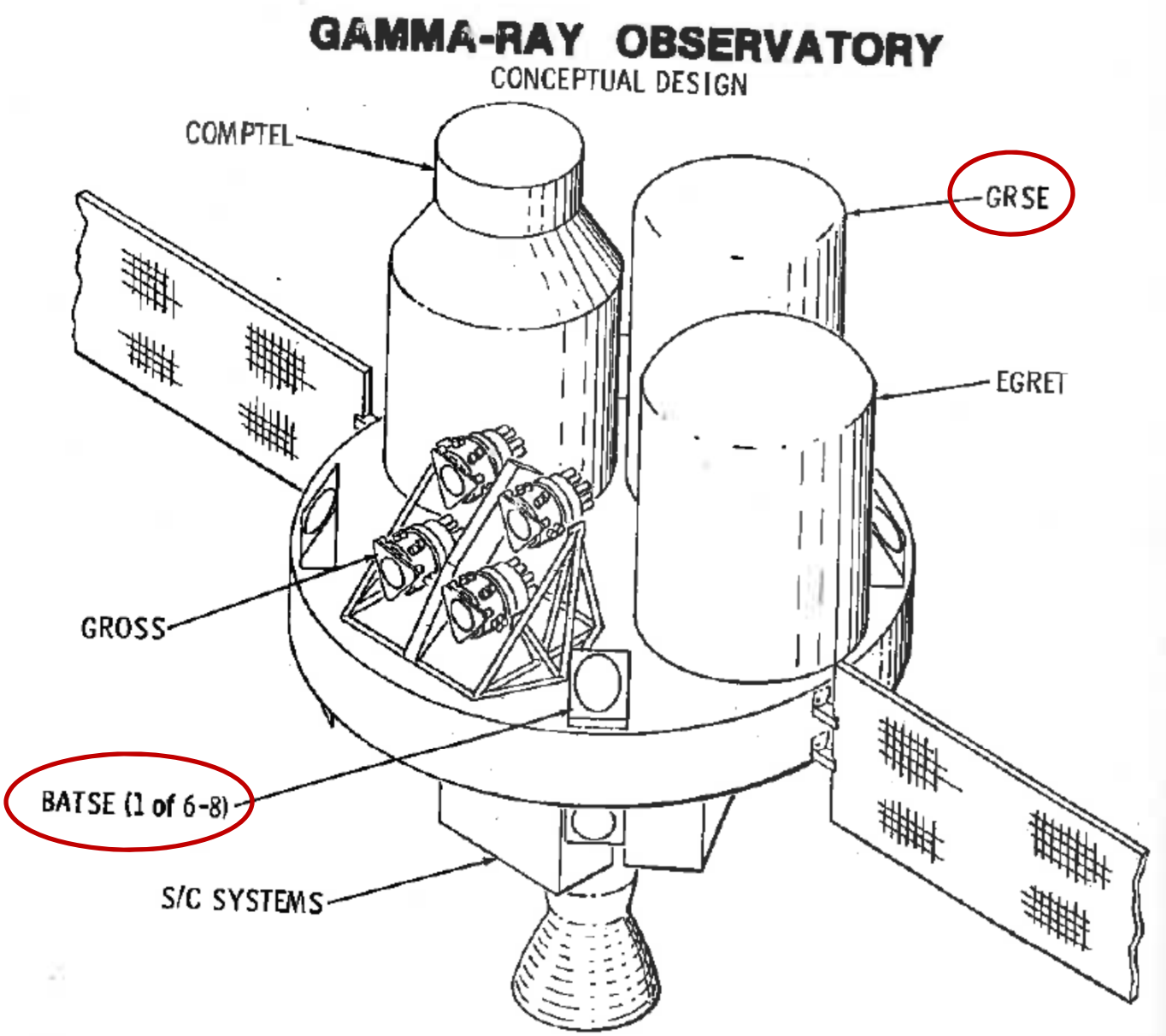
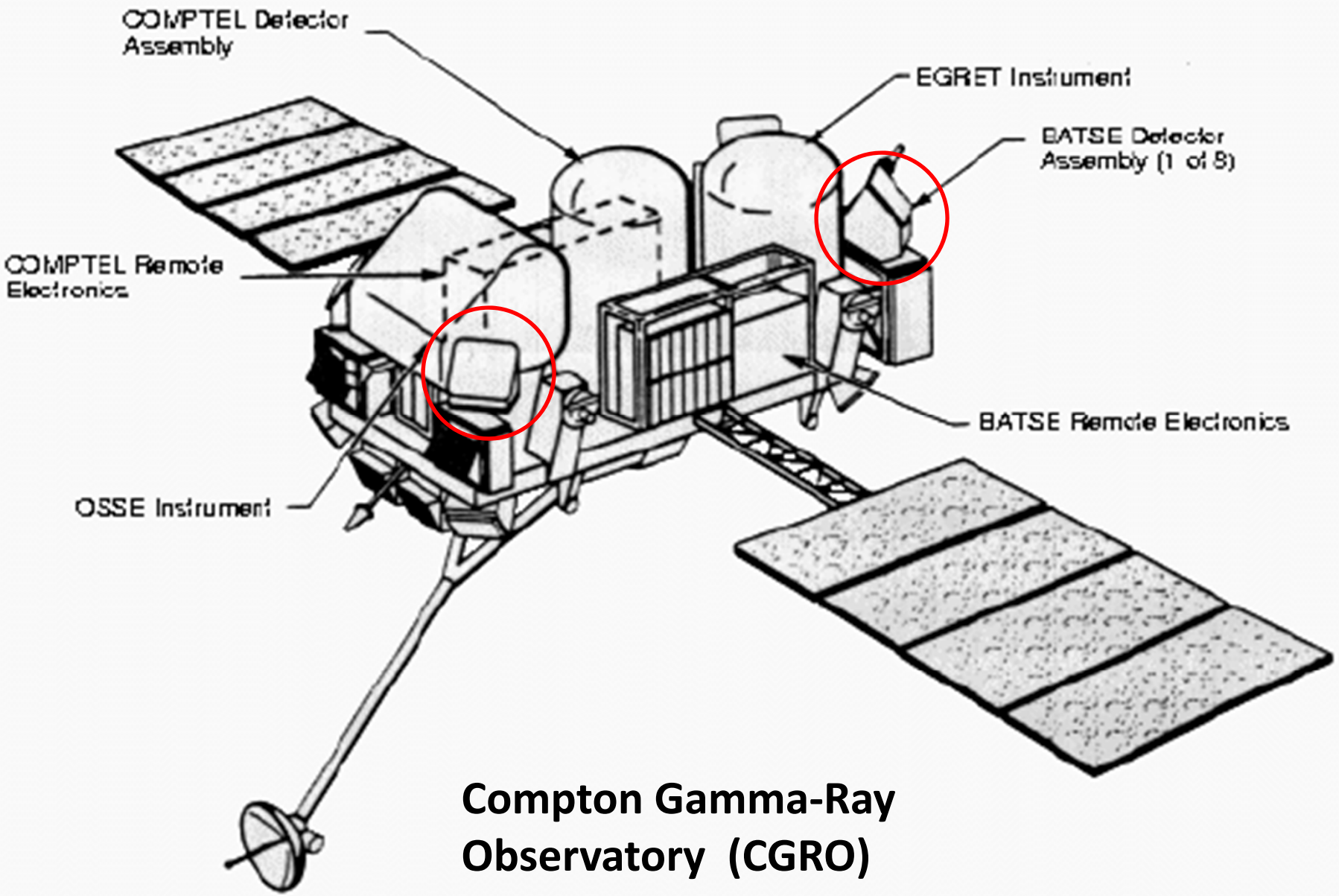


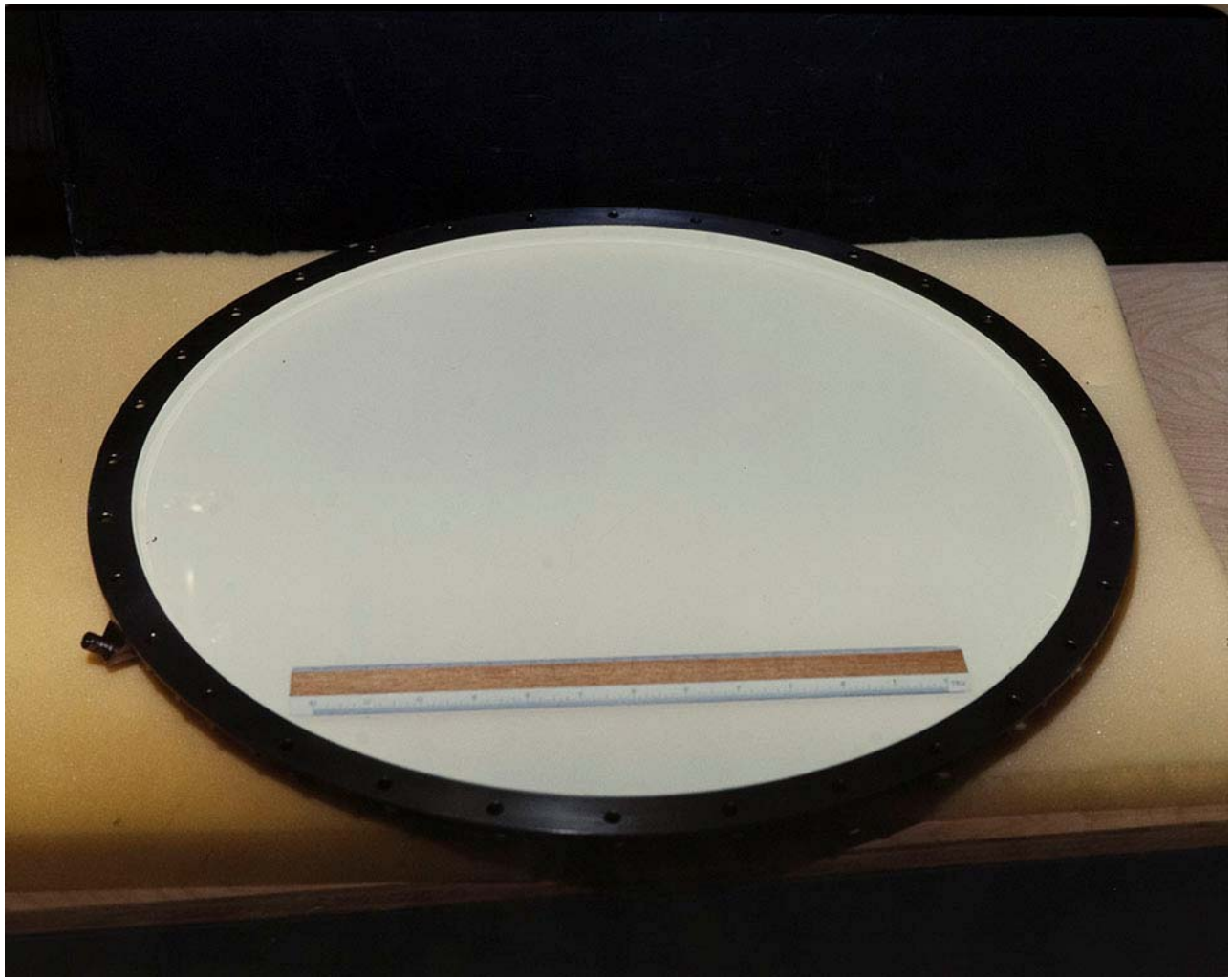
Fig. 3. Conceptual drawing of the planned Gamma-Ray Observatory (GRO) showing the four major pointed experiments and a possible configuration for the BATSE array.

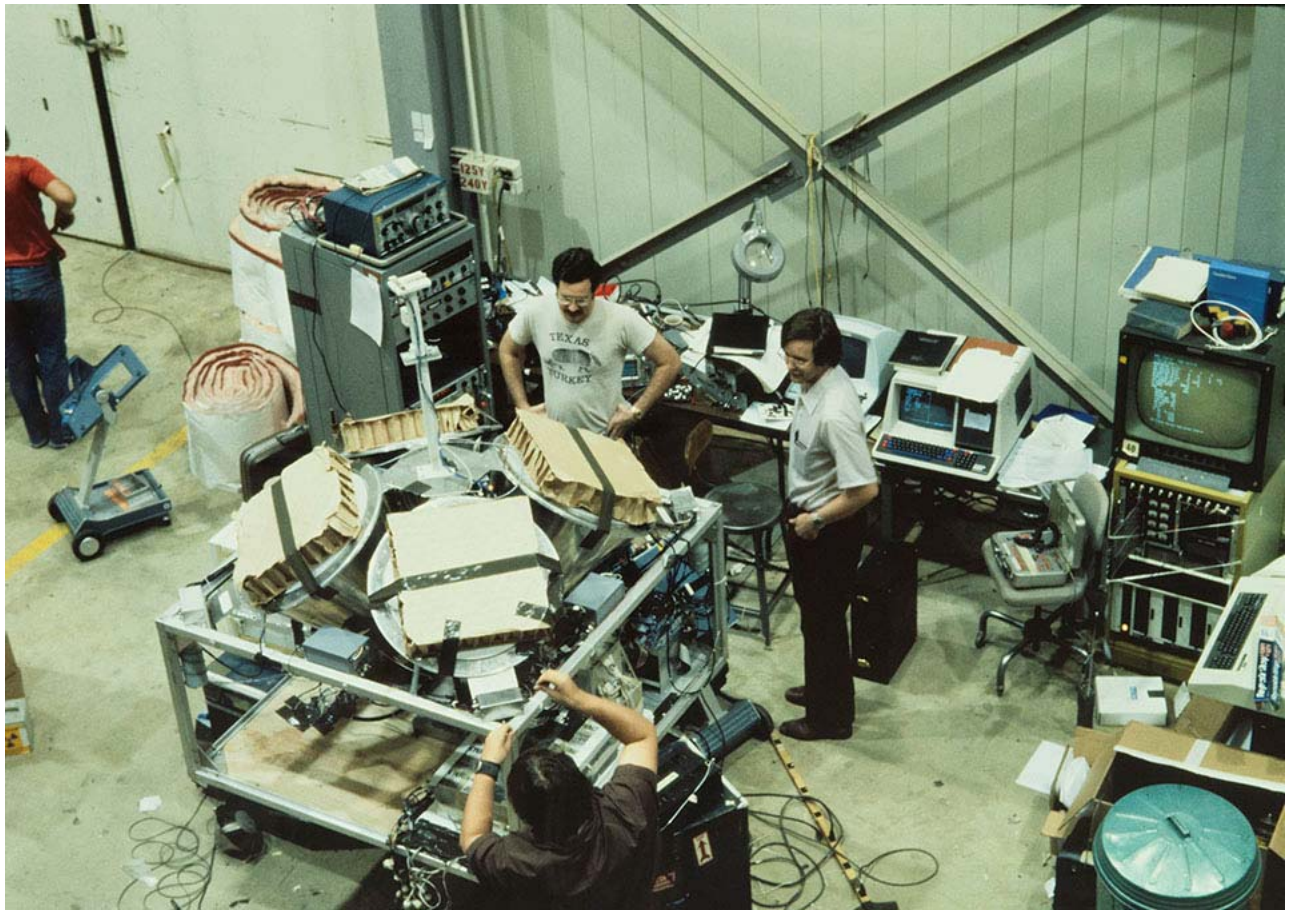


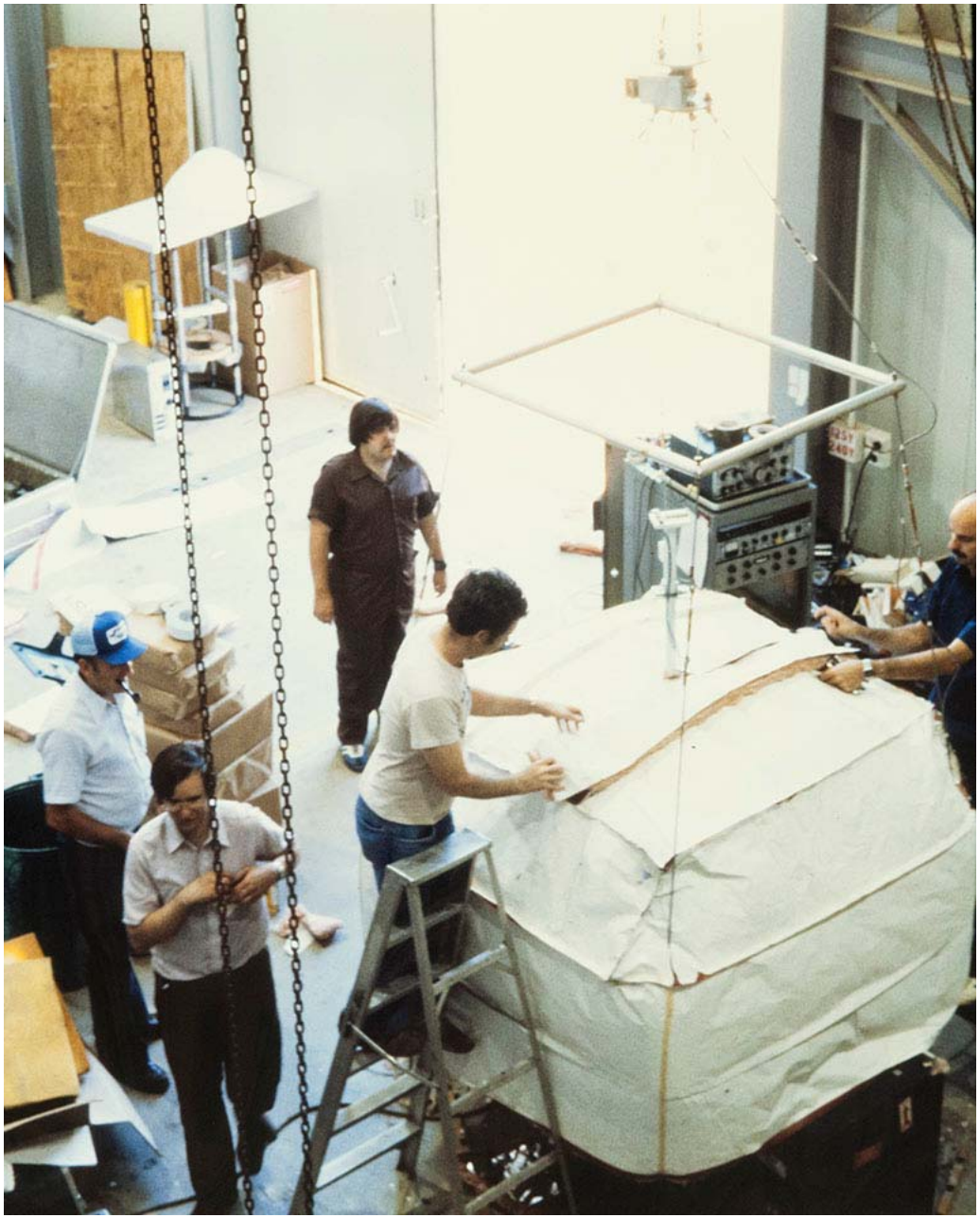
Compton Gamma-Ray Observatory (CGRO)

BATSE Detector Development & Balloon Flights

1980 - 1987




125V
240V
TEXAS
TURKEY

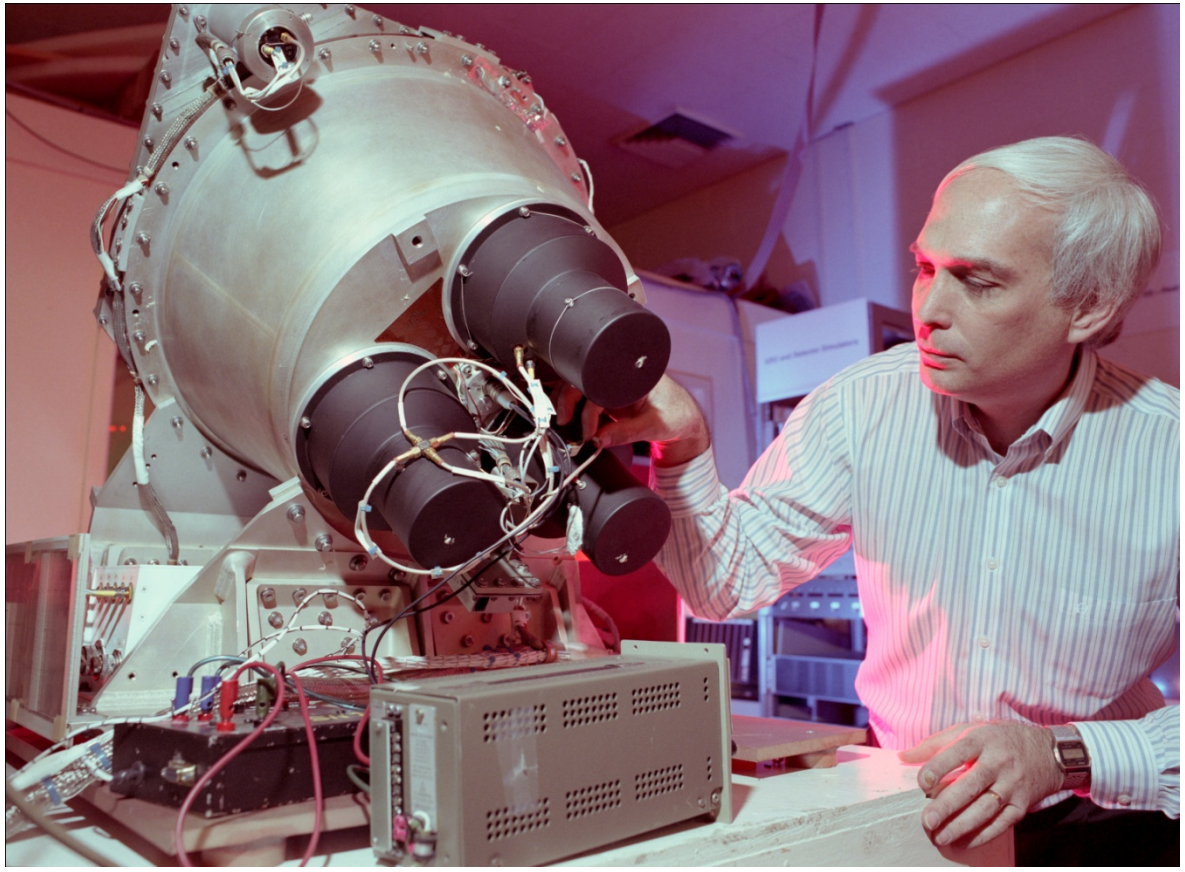



NSBF

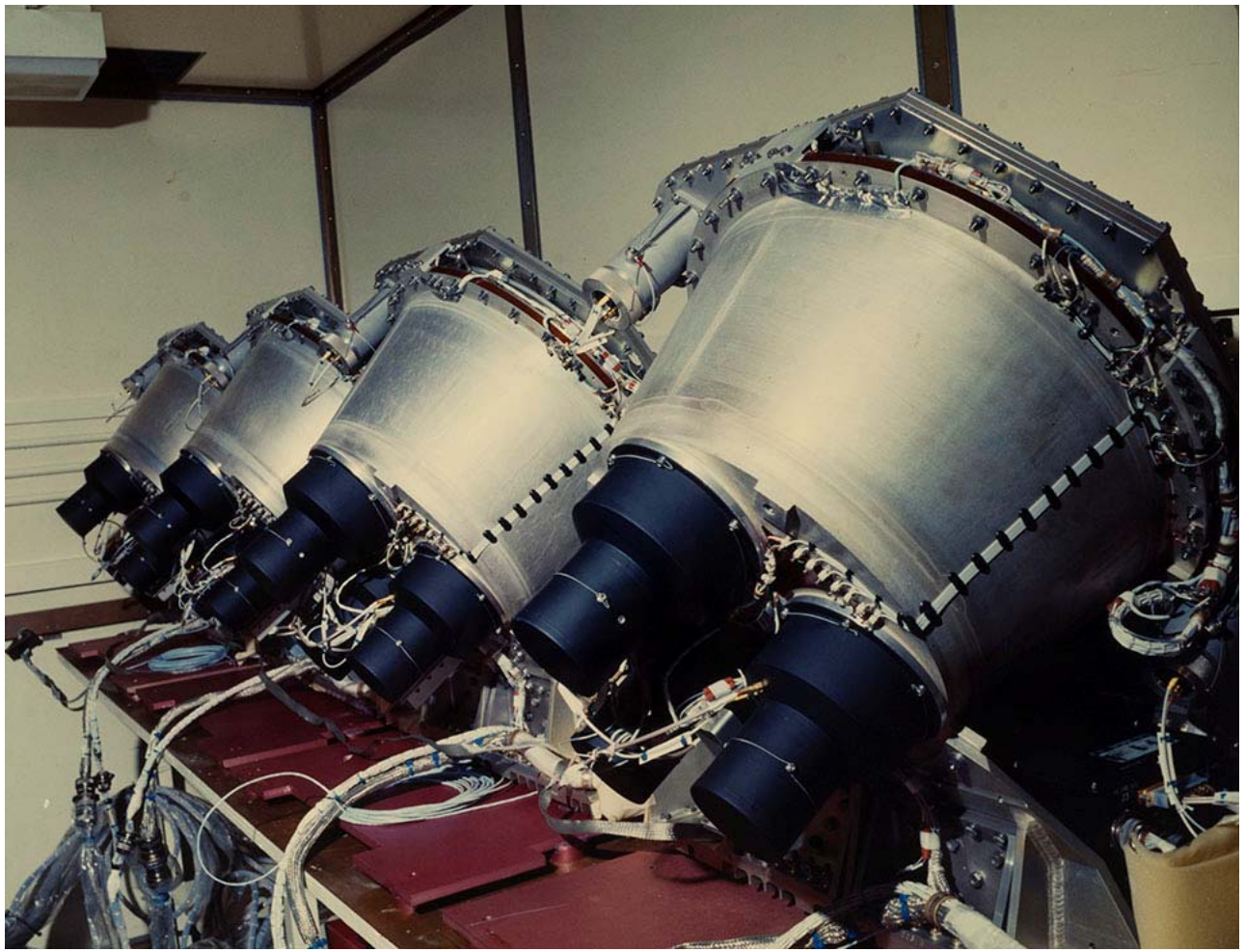
Building BATSE & GRO

1982 - 1989

BATSE Detector Module



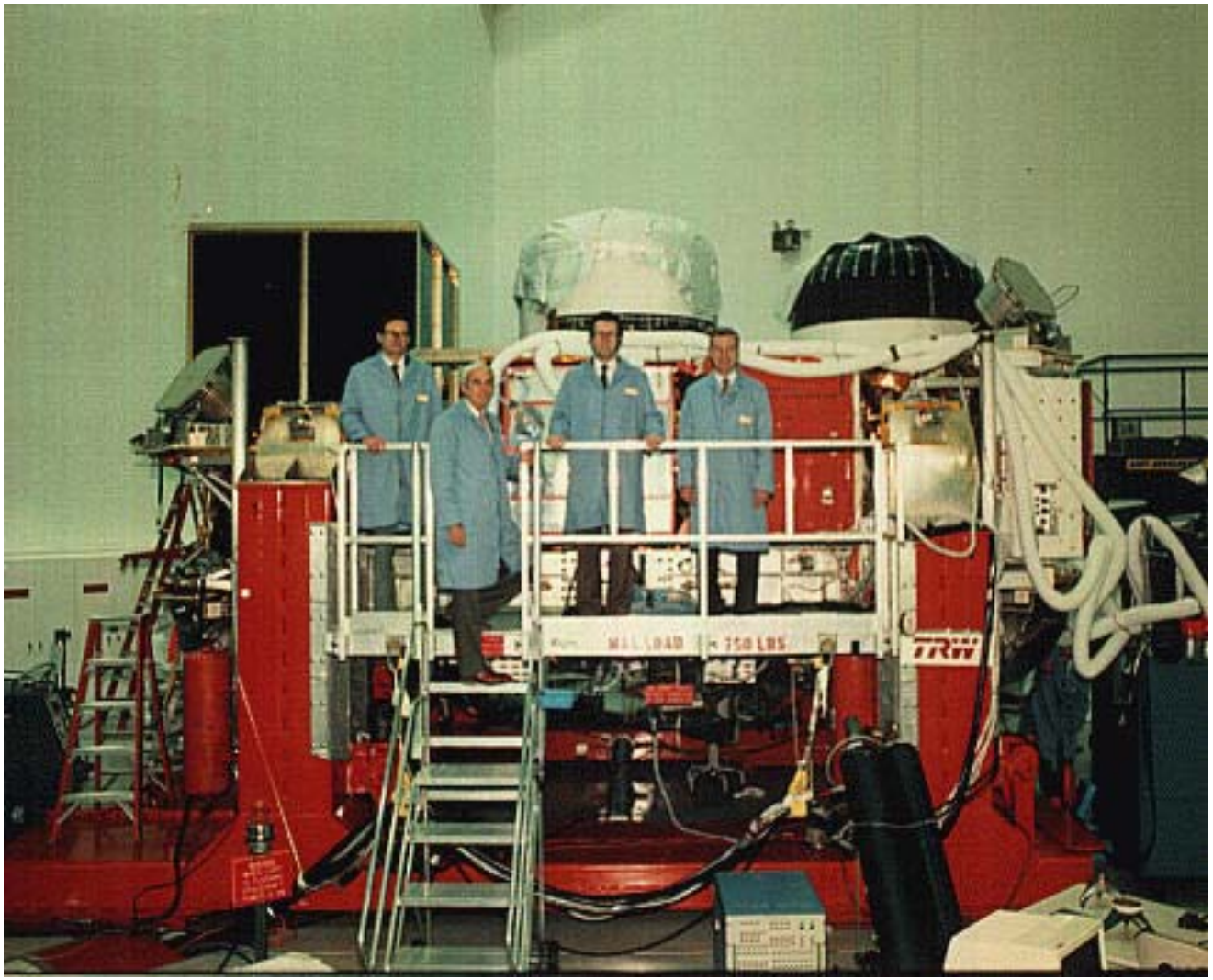
BATSE Detector Modules:
- Design, Fabrication, Testing & Calibration at NASA-MSFC



Integration of Experiments on GRO Spacecraft in California

Radioactive Source Survey of BATSE on the GRO Spacecraft in

GRO P.I.s Near the GRO Instruments



Launching
&
Deploying GRO

April 4-5, 1991

Shuttle launch – Gamma-Ray Observatory (GRO)

(Operational: re-named CGRO)


MF57G
MF57H
MF57K
STS-37
Atlantis
STS-37
Atlantis

nature

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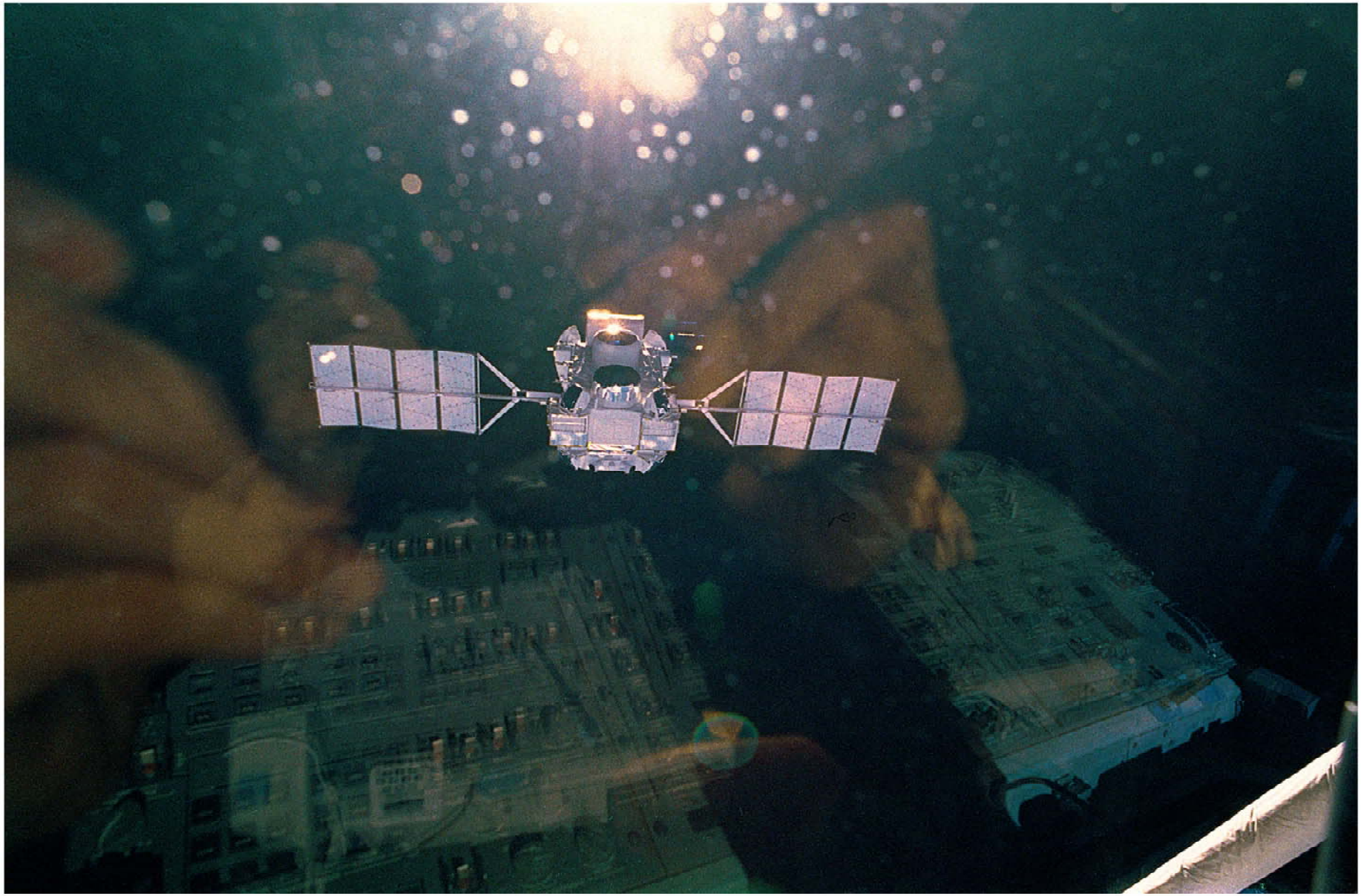
MAPPING COSMIC GAMMA-RAY BURSTS

An inventory for the origins of life

More pulsar planets

Atomic structure of bacteriophage ϕX174



BATSE

First large experiment designed for GRB studies:

- **Full-sky**
- **Large area**
- **Good sensitivity for E_{peak} of most GRBs**
- **Moderate spectral capabilities – (good enough for most time/spectral correlations and time resolved spectral studies**

BATSE - Major GRB Results

- **Global properties of GRB Distributions:**
  - **Intensity Distribution & Sky Distribution**
  - **Not consistent with any Galactic Distribution, nearby extra-gal objects, incl. large clusters**
  - **Strong Indications that GRBs were at cosmological distances (Although BeppoSAX nailed it)**
- **Comprehensive Temporal/Spectral Studies**
- **Two Populations of GRBs**
- **Rapid GRB Response: beginning of Bacodine/GCN - led to breakthrough wide-field observations (e.g. GRB990123)**

BATSE Legacy

- **Largest sample (2704); full-sky, 9+ years in operation**
- **Well- characterized, full-sky instrument**
- **Likely will not be exceeded for several decades**
- **Led to GCN Network (S. Barthelmy)**

➢ **Many Hundreds of Papers Based on BATSE Observations; >50 Ph.D. theses**

The End

Back-up Notes:

- First thoughts on GRB Observations:

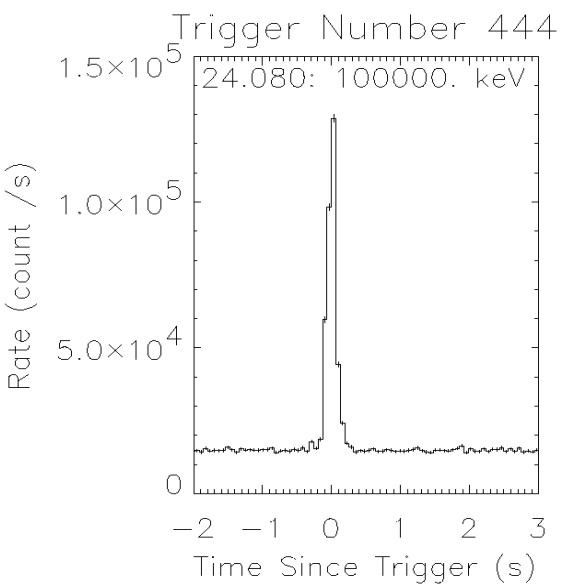
  Good field (nothing is known & high S/N)
- Need Large area to get many; remembered - 3/2 power law: will give ~several GRBs/day
- Low-cost balloon flights others had same idea
- - propose for GRO (>>after Ltr. of Intent was due!

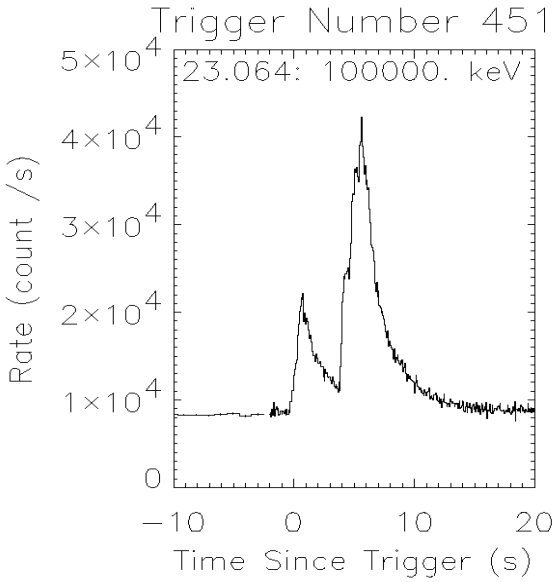
- Low cost; propose as signal to others.
- Propose dodecahedron (12) - 6 on top & 6 on bottom)
- Bottom was accepted; not the top, with 2 spares
- Fly the spares; need full sky w. same detectors; eight det. only (later a spare was approved

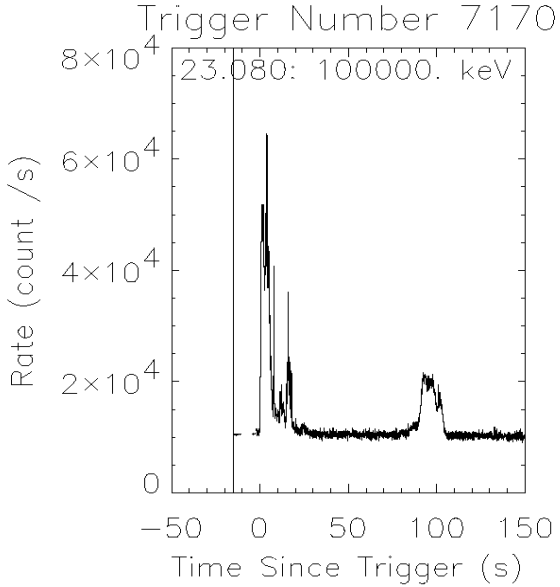
A Few Major BATSE GRB Results

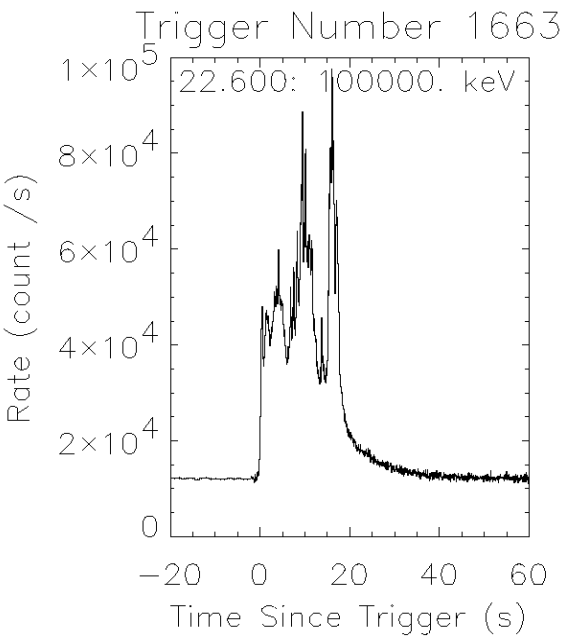
1991-2000

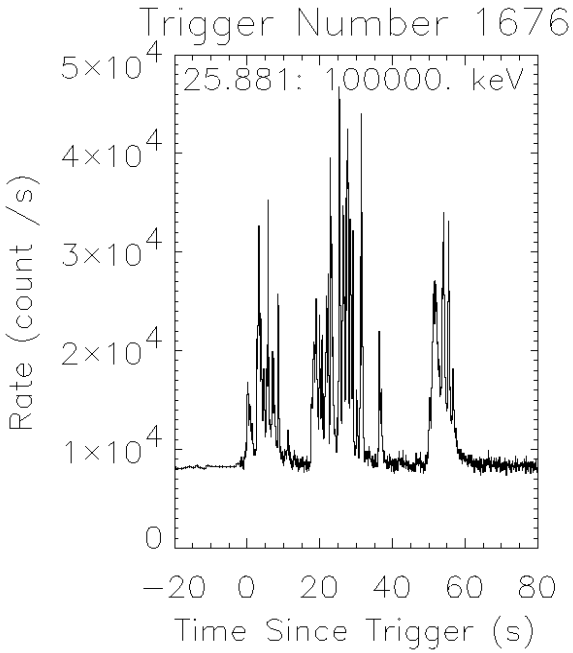
Diversity of GRB Profiles & Coupled Spectral / Temporal Properties



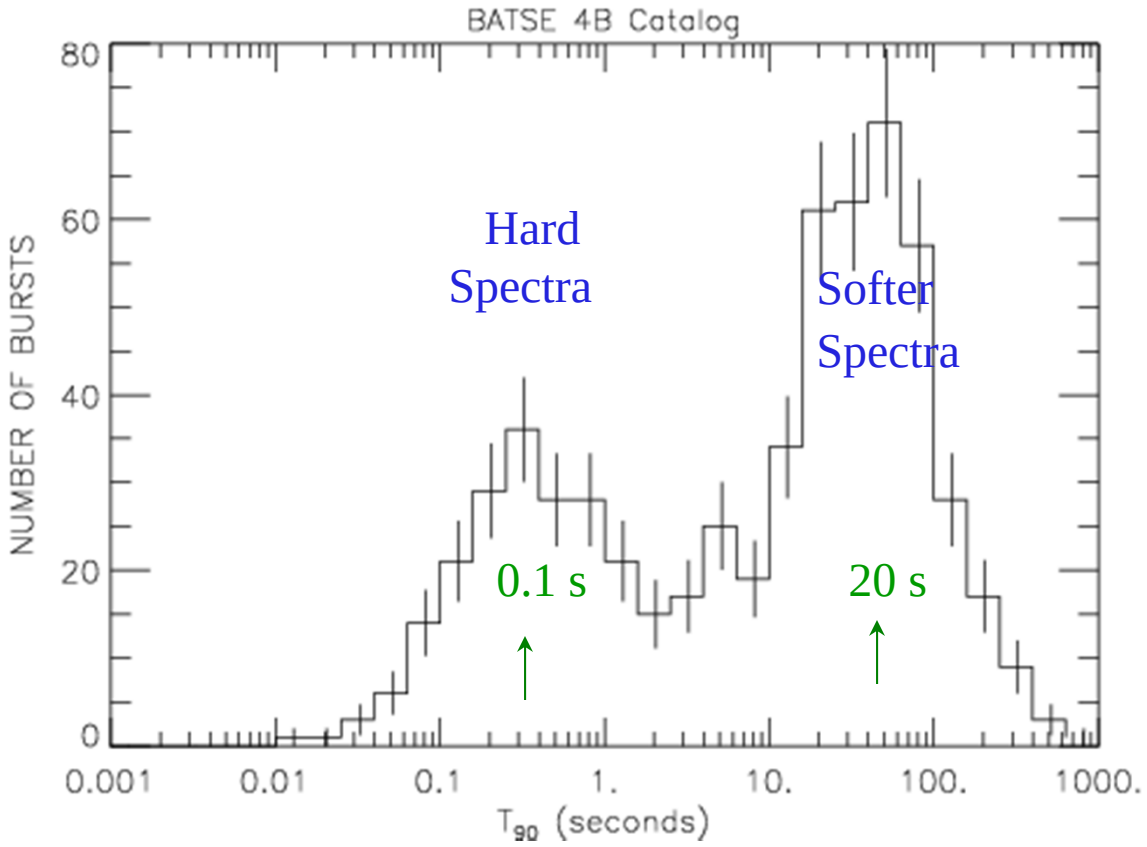


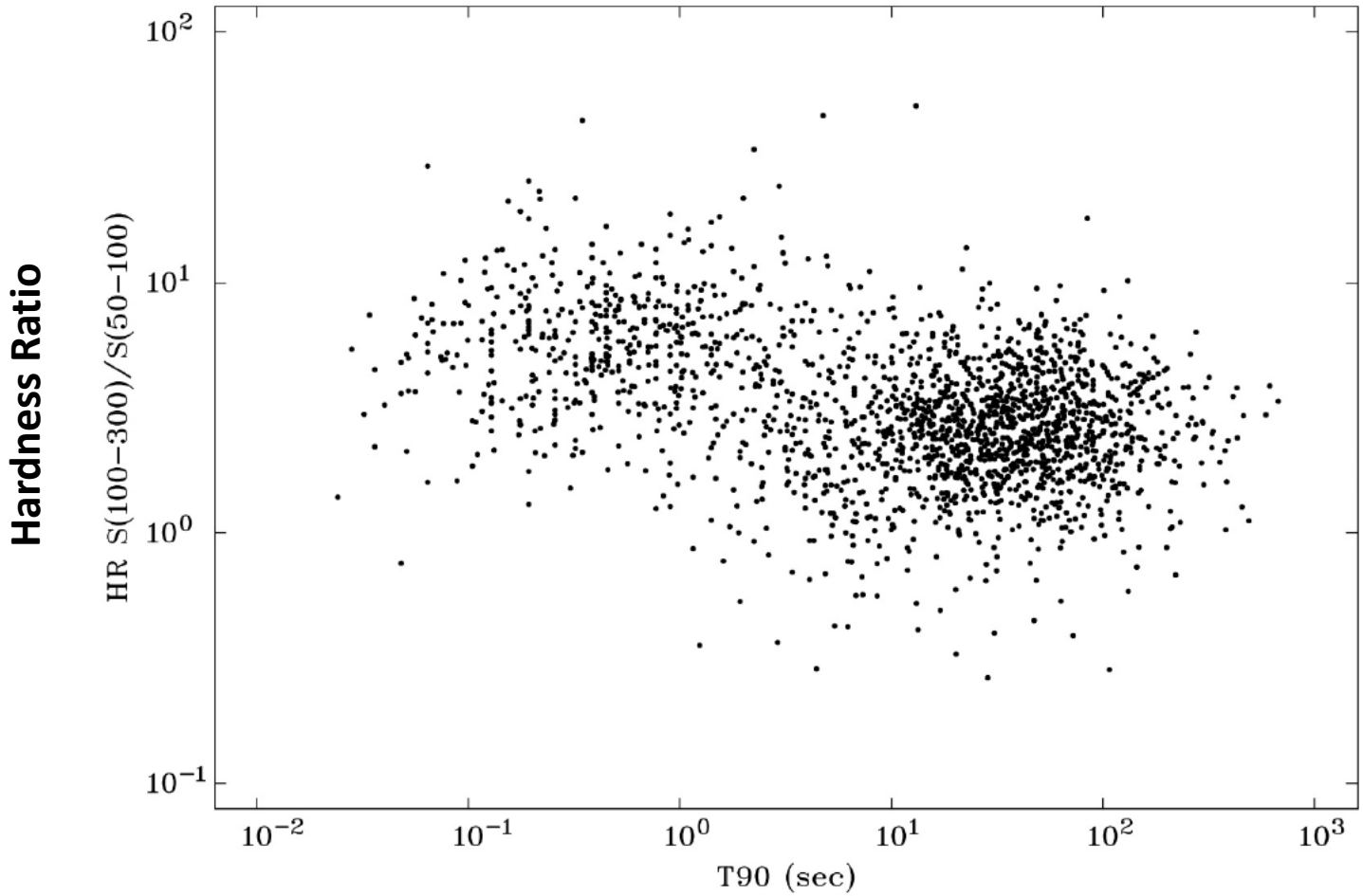




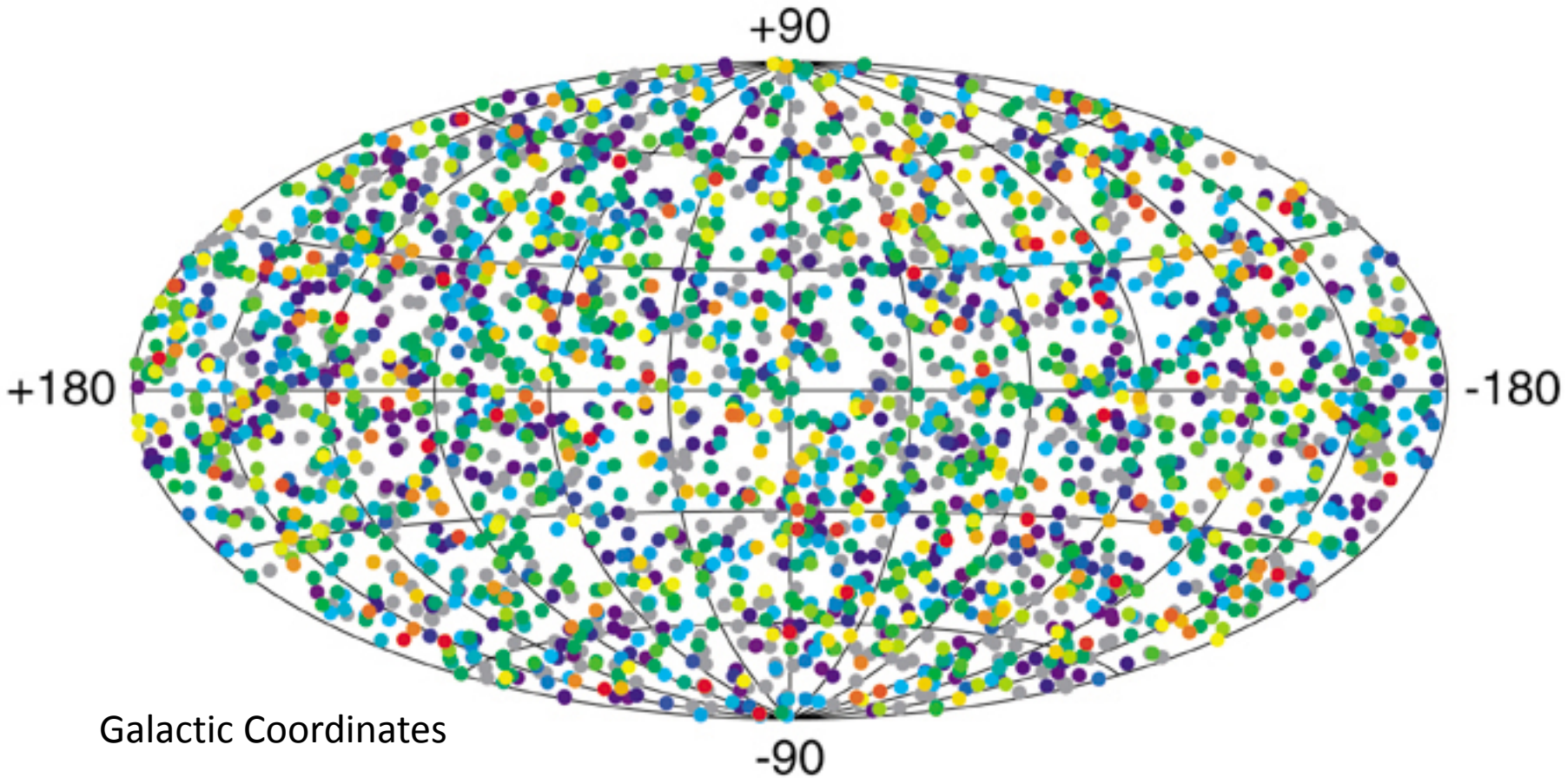


Two Distinct subclasses of γ–ray bursts: short/hard & long/soft



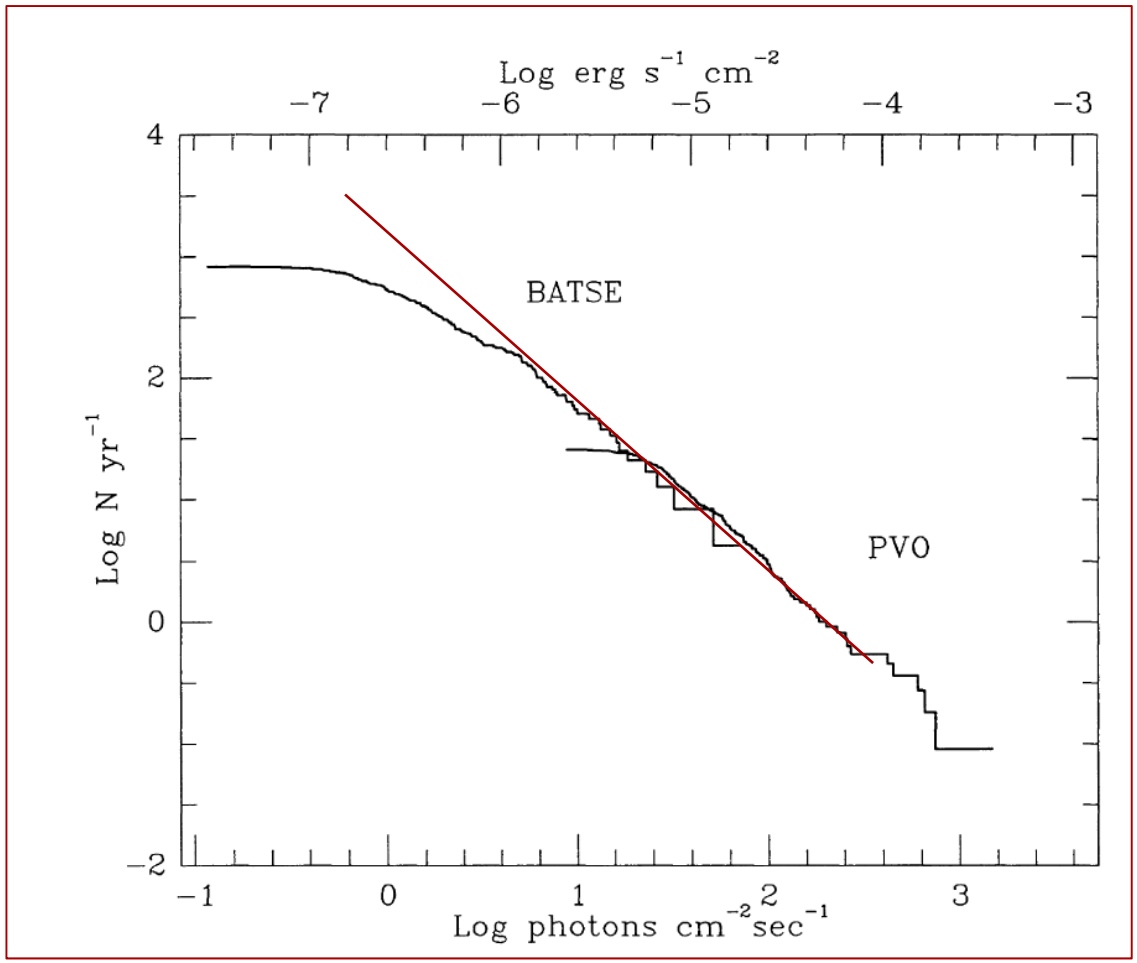

Hardness Ratio
HR S(100−300)/S(50−100)
10^2
10^1
10^0
10^{-1}
10^{-2}
10^{-1}
10^0
10^1
10^2
10^3
T90 (sec)
Duration of Gamma-ray Bursts (sec)

2704 BATSE Gamma-Ray Bursts



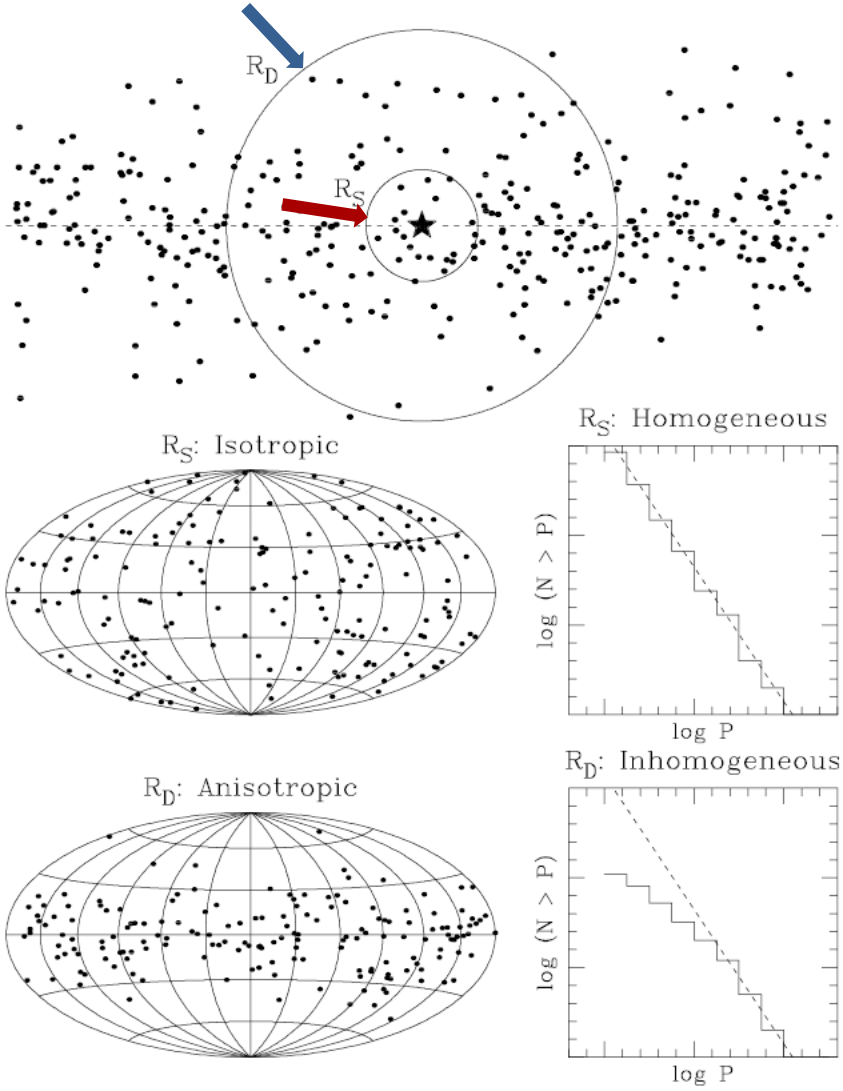
Galactic Coordinates

Apr. 1991 – May 2000


Log erg s^{-1} cm^{-2}
−7
−6
−5
−4
−3
4
2
0
−2
Log N yr^{-1}
BATSE
PVO
−1
0
1
2
3
Log photons cm^{-2} sec^{-1}

R_S - Galactic, Nearby

R_D - Galactic, Far away



R_S - Galactic, Nearby

R_D - Galactic, Far away